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[seal]

Two-stroke engine with multiple cylinders.

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The engine that is the subject of this invention is of the barrel type, and its shaft is tubular or solid, straight, and surrounded by an even number of uniformly distributed twin pistons. At the opposite ends of said twin pistons, affixed to flanges, are the corresponding cylinders, which are diesel or combustion-powered.

In order to take on a continuous circular motion imparted by the elemental back and forth motion of the twin pistons, the shaft passes at a slant through the central portion of an attached plate built into a two-part hub equipped with appropriate guidance devices and thrust bearings.

Since this plate has as many arms as there are twin pistons, in order to drive the former, each of the latter is equipped with a sort of slide that takes on a semi-rotary floating motion that provides substantial mechanical advantages.

The characteristics and advantages of the invention will be better understood with reference to the embodiments illustrated by the attached figures, which are provided as non-limiting examples and do not preclude variants modeled on those designs.

Figure 1 shows a diametral section of a valve engine according to the invention.

Figures 2a and 2b refer to one of the twin pistons of this engine.

Figure 3 shows a lengthwise diametral half-section of a valveless engine according to one variant of the invention.

The shaft 1 is perfectly straight and has no crank or similar mechanism. It is driven by a star plate 2 through whose center the shaft 1 passes at a slant.

Acting simultaneously on the star 2 are an even number of identical twin pistons, such as 3-3', distributed uniformly around the shaft 1, axially to the two fixed cylinders 4 and 4' that correspond to them, respectively. The respective cylinders 4 and 4' of pistons 3-3' have their valve and ignition control suitably adjusted in sequence to achieve the following result, repeating, with a timing delay, for all 3-3' / 4-4' groups of the engine, by means of a similar adjustment of the valve and ignition controls in the cylinders corresponding to said pistons. During the first half of a complete double stroke by a 3-3' group, the motion of one of the pistons in its cylinder develops drive thrust that, when transmitted to the other piston, allows it to exert compressive force in its cylinder. These roles are naturally reversed when the twin piston moves from the first to the second half of its complete stroke.

The star 2 is built into a device that provides its central guidance by a two-part hub comprising a roller bearing 5 and two thrust ball bearings 6 and 6'. Due to the central bearing 5, the thrust bearings 6 and 6' do not have to work in a plane perpendicular to their tracks.

On each side of this device, the drive shaft 1 passes through two flanges 7 and 7', which comprise ball bearings 8 and 8' and thrust bearings 9 and 9'.

Two other bearings 10 and 10' positioned at the ends of the shaft 1 complete the guidance of said shaft.

These are the mechanisms that enable the collective transformation of the alternating motions of pistons 3-3' into a continuous rotation motion of the shaft 1 under optimal mechanical conditions and with a minimum of friction.

Note that the opposing action of the pistons 3-3' almost entirely eliminates first and second degree reactions.

Also note that judiciously placed reinforcements of the metal make it possible to further complete the aforementioned balance of forces.

In short, the above data are for information only and it is possible to depart from it if, in a particular embodiment, there is a potential for achieving the maximum recommended usage speeds for the thrust ball bearings. In that case, plain thrust bearings, such as Mitchell bearings, for example, could be used.

For the solid shaft illustrated in the figure, it is possible to substitute a hollow shaft, which may be appropriate for use under certain circumstances.

The star 2 comprises as many arms 12 as the engine has twin pistons 3-3', and between the pistons of each pair, in order to drive the star 2, there is a sort of built-in slide 16, whose motion is particularly advantageous, because it is a floating semi-rotary motion. This is a gentle motion, resulting in minimum wear, which further lends itself to excellent lubrication.

Still other advantages arise from the relatively great length of the pistons. This results in minimizing the unit pressure exerted on the surfaces and greatly facilitates their cooling.

However, the mobile devices that compose the engine retain the advantage of lightness, which eliminates the drawbacks of imbalance and the effect of inertia on the machines.

The cylinders form perfect bodies of revolution and the valve cages installed at one of their ends have openings that are not perpendicular to the axis, which promotes a circular scavenging that efficiently contributes to proper evacuation of waste gases.

The scavenging further provides advantageous uniflow conditions. Not only does the engine have overall symmetry with respect to a lengthwise diametral plane, but also considerable symmetry with respect to its mid-plane cross-section.

Since they are all identical, the cylinders are economical to use, regardless of their number. There is a very broad choice in determining the amount that is most appropriate for a given engine. The only numbers that are not advisable are even numbers that are multiples of four, which would subject the slides to excessive axial motion.

The cylinders are perfectly parallel and distributed in a barrel parallel to the shaft 1. Their open end is built into a flange 7 and 7' whose central portion comprises the appropriate thrust bearings and ball bearings.

At its opposite end, each of the cylinders has a valve cage 11-11' fit tightly onto a scavenging manifold 12-12' between the cylinder and the valve guide 13-13'. Said guide is equipped with an appropriate thread.

The assembly composed of the flange and the manifold is pinned to the drive shaft 1, which it maintains through the intermediary of the four aforementioned bearings 8-8' and 10-10'.

The two cylinder flanges are maintained at the desired distance by spacers and the engine housing contributes to maintaining the cohesiveness of the assembly.

The two cams 14 and 14', which are placed on the drive shaft in front of each scavenging manifold, may be sufficient to control the valves.

Each cam activates the valve lifters 15-15', one after the other, by means of a rocker arm that controls the valves of each cylinder.

Ignition is provided by one or two devices of either the distributor-cap type or the magneto type, which require no explanation, since they are not part of the invention.

However, a different type of ignition may be substituted, composed of an appropriate number of contact breakers (which may be equal to half of the number of cylinders). In this system each of these powers a high voltage ignition coil, with each output connected to a spark plug placed on each cylinder in 180° opposition.

Using the principle of firing ignition, the invention could also use a line to connect two successive cylinders at the appropriate moment. Said line may or may not comprise a control valve. The lines in question could then discharge into one of the cylinders at the desired height, in order to ignite the subsequent cylinder at the appropriate time.

These lines may or may not be equipped with compressor valves to avoid any back flow.

As a simple and adequate cooling mechanism, the invention further provides for a flow of air produced by a turbine fan placed on the drive shaft and located in the middle of the fins of a group of cylinders. Baffles or manifolds could be installed to guide the cooling air to the machine.

The scavenging air also very efficiently contributes to the internal cooling of the engine. If necessary, it would be possible to use liquid cooling, which would be very easily adaptable to this device.

As with cooling, there is a very broad choice for lubrication, and the choice that has been made here is non-limiting. According to this example, a circular groove supplies the engine hub. In addition, there are passages inside the arms of the star 2, for lubricating not only the roller bearings, but also the thrust bearings, slides, and pistons.

An appropriate oil pump may supply lubricant liquid not only to the aforesaid lubrication groove, but to openings in the engine cylinders provided for that purpose.

In addition to the valve engine using the aforementioned designs, the invention allows for a valveless engine, modeled on these, providing, as a non-limiting example, the general characteristics indicated in the above description.

To produce the valveless engine, half of which is illustrated in Figure 3, the primary modifications to be made would be, for example, the following:

The distribution of the scavenging and evacuation would be achieved by means of a sleeve that may or may not be controlled by a mechanism of the type described above.

A disc would be installed on each side of the engine hub, slanted with respect to the drive shaft, and placed between fixed stops. Each of these discs would be pierced with as many openings as there are sleeves to be controlled.

A pin would be placed in each opening to impart the desired floating motion to the sleeves.

In this type of engine, it would be advantageous to conduct the scavenging in the reverse direction to the one used in the engine described above, in other words, the scavenging would occur from the center toward the ends of the cylinders, and the exhaust would be placed at the two ends of the engine.

The engine variant would also borrow many construction details from the valve engine described above, which would require no alterations. However, in its essentials, its composition would be characterized by Figure 3 and the following respective legend:

1. Straight drive shaft
2. Star
- 3 and 3'. Opposing pistons
- 4 and 4'. Opposing cylinders
5. Guidance bearing
- 6 and 6'. Star thrust bearings
- 8 and 8'. Guidance bearing of the shaft 1
- 9 and 9'. Thrust bearing of the shaft 1
- 12 and 12'. Scavenging manifolds
16. Slide with guide
- 18 and 18'. Discs
- 19 and 19'. Exhaust manifolds
- 20 and 20'. Exhaust and scavenging sleeves
- 21 and 21'. Cooling sleeves

Note that, since the hot part of the cylinder is placed at the ends of the engine, any mechanical assembly is cooled by the scavenging air.

The invention for which two embodiments have just been provided has the considerable advantage of being equally applicable to two-stroke fuel-injected uniflow scavenging engines powered either by gas or by fuels commonly used for diesel engines.

In addition to this general advantage, there are also a number of practical advantages, including the following:

1. The drive shaft is perfectly straight.
2. The construction of the engine, in any of the above variants, does not require more than twenty different special parts, which are practically all perfect bodies of revolution.
3. The total number of parts is less than one-tenth the number required by a normal engine.
4. The new engine is entirely mounted on five roller bearings and four thrust bearings.
5. The new engine is simple and subject to only a minimum amount of friction.
6. The balance is optimal and the cycle perfectly regular.
7. The engine very easily achieves a very long stroke (one and a half times the bore, for example).
8. The very long guidance of the pistons greatly promotes their cooling.
9. The combustion chambers may be hemispheric in shape.
10. A single valve per cylinder is sufficient to operate the first engine described, and example two operates with no valves.
11. Clean air scavenging allows internal cooling of the engine.
12. Uniflow scavenging provides total evacuation of waste gases.
13. Cylinder loading is optimal and the very short length of the pipes have a diameter triple that of normal engines.
14. The invention easily remedies engine power losses at high altitudes.

15. Combustion in a cylinder is always directly opposed to compression in the associated cylinder (of the same pair), which greatly promotes mechanical efficiency and engine flexibility.

16. Its weight is very greatly reduced. The front surface and height are also reduced.

17. Lubrication is very much simplified.

18. As a result of certain conditions enumerated above, engine consumption is reduced to a minimum.

19. Its very great simplicity allows for construction and maintenance at an exceptionally low cost price.

Finally, to indicate the scope of the advantages of the invention relative to the construction and maintenance of this type of engine, we have done a special study of an engine that provides a concrete example, and whose practical conclusions may be applied to various levels of manufacturing of these same types of engines.

This concrete case study (of a two-stroke, 12-cylinder engine) has provided a complete statistical report on the required special parts, which are largely interchangeable, compared to the number of commercially available parts.

A. The following parts are special (but largely interchangeable):

1. Twelve cylinders
2. Twelve pistons
3. Six slides
4. One six-armed star
5. One two-part plate
6. One drive shaft
7. Two flanges
8. Two scavenging manifolds
9. Twelve rocker arms
10. Two rocker arm assemblies
11. Twelve valve guides
12. Two cooling turbine fans
13. Two scavenging valve control crms
14. One two-part crankcase

This list shows that the number of parts totals 68, but there are only fourteen different models.

B. The other commercially available parts, such as valves, springs, rollers, thrust bearings, retainers, studs, nuts, screws, and bolts, are shown in the list below:

1. Twelve valves
2. Two rollers with pins
3. Five ball bearings
4. Four thrust ball bearings
5. Two yoke plate nuts
6. Two cam nuts
7. Six spacers with 12 nuts
8. Ninety-six 8 mm bolts
9. Thirty-six 5 mm bolts
10. Thirty-six 7 mm nuts
11. Twenty-four 5 mm nuts
12. Thirty-six 7 mm studs
13. Twenty-four 5 mm studs

This list shows a total of two hundred ninety-five parts, of which nuts and bolts comprise the majority.

Of course the following must be provided:

Either an ignition device with a distributor cap and spark plugs;

Or a fuel-injection device with a pump and fuel injector. A scavenging device requiring only a fan.

SUMMARY

The invention concerns a diesel or combustion barrel engine, with or without valves, whose shaft is straight and tubular or solid, surrounded by an even number of uniformly distributed twin pistons and, more generally, concerns all engines with the following characteristics, taken separately or in various combinations:

1. Between the twin pistons, which have an elemental back and forth motion, and the coaxial shaft, which has a continuous circular motion, functioning as a connecting and motion transfer device, there is a slanted or "star" plate on the shaft side and a "slide," which has a semi-rotary floating motion, on each twin piston side.

2. Corresponding with the pistons mounted on either side of each twin piston according to 1 above, there are cylinders affixed to flanges, powered by gas or diesel fuel, which operate in opposition in each group.

3. The star according to 1 above is built into a two-part hub comprising essential guidance elements, roller bearings and thrust bearings.

4. Attached to the cylinders that correspond to the twin pistons according to 2 above are valve cages whose openings are on a slant with respect to the axis and, by circular scavenging, promote optimal evacuation of waste gases.

5. Scavenging is uniflow.

6. Scavenging manifolds, attached to the flanges, and comprising bearings appropriate to the path of the drive shaft are tightly fit onto the cylinders according to 4 above.

7. Valves according to 4 above are controlled by two cams placed on the shaft in front of each scavenging manifold. These cams activate valve lifters, one after the other, to control the valves in each group.

8. Ignition may be provided by standard mechanisms, either by a magneto or a distributor cap.

9. Ignition may also be provided by firing.

10. Using high-voltage dual output coils, a number of contact breakers equal to half of the number of cylinders may also power spark plugs respectively assigned to the cylinders in 180° opposition.

11. Compressor valves may be used in lines in order to avoid back flow.

12. Engine cooling may be provided by a fan, combined, if desired, with an appropriate baffle system (this mechanism is non-limiting).

13. Also in a non-limiting matter, lubrication may be provided by a circular groove, supplying the hub, and comprising passages inside the arms of the star, thereby lubricating the roller bearings, thrust bearings, slides, and pistons.

14. The valveless variant is based on the same designs as the valve engine and comprises the same aforementioned characteristics.

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By proxy:

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No. 1,450,354

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2 plates – Plate 1

FIG. 1

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2 plates - Plate 2

FIG. 2a
FIG. 2b
FIG. 3